

## Emerging Synthesis of Social Manufacturing

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### Abstract

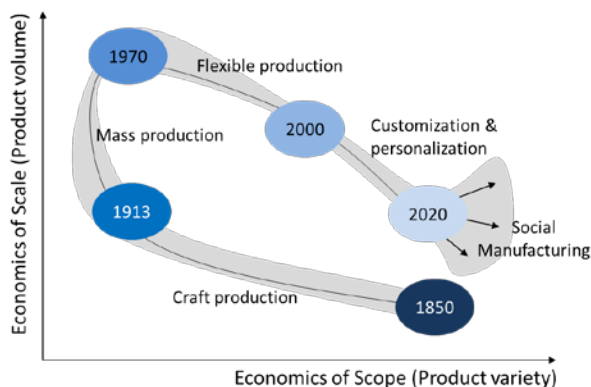
Manufacturing systems has changed constantly throughout the years and new theory towards value creation is emerging. The latest manufacturing paradigm is described as social manufacturing which uses open design platforms. Open design platforms could give the hands of every individual the means to produce physical objects or products. Nowadays, with the wave of the Internet of Things (IoT) people can participate from global communities to contribute to the innovation process. Everybody can use existing design tools and solutions on open platforms. This will ensure co-creation to produce even more solutions. Social manufacturing harnesses the emerging synthesis from open design platforms and the manufacturing capability that is embedded within the online community platform, whereby the users co-manufacture their own products. This paper discusses an one week challenge case study that investigates the possibility of completing the open design process of a product during a limited timespan using social manufacturing techniques. This case study proved that a product can be crowd sourced and delivered within a week. These results showed that the desired industrial cluster could be reached. These social elements are promising for future manufacturing businesses.

### Keywords

Social manufacturing, Crowd sourcing, Open design

## 1 INTRODUCTION

Manufacturing has been fundamental to prosperity and national development. A strong manufacturing platform is important to any community or society, because it contributes to all the other sectors of the economy. This means manufacturing deserves strong endeavour of all factors in modern society to ensure better life, prosperity and sustainable development. There have been many revolutionary changes to manufacturing throughout the years as illustrated in figure 1. According to Koren *et al.* [1] the change in the manufacturing paradigms are caused by changes in societal and market imperatives, and the development of new enabling technologies.



**Figure 1** - Change in manufacturing paradigms with regards economics of scale and economics of scope [2]

The craft production paradigm enabled society to focus more on the economics of scale. This

paradigm was supported with the invention of assembly lines. Around the 1970's the market was saturated with specific products, which was mass produced, and society demanded greater product variety. Thereafter, we moved into this era of customization and personalization. However, there is a new manufacturing revolution on the horizon and it is called social manufacturing. Manufacturers will produce products on social manufacturing platforms, while new small companies or local suppliers and customers will develop the products using open design platforms [2].

The latest Internet of Things (IoT) industrial revolution [3], [4] have ignited manufacturing strategies in countries around the world such as the Catapult (UK), SIP in Japan, Industry 4.0 (Germany) [5], [6], [7] and NNMI (US). Kagermann *et al.* [8] describe this revolution as the convergence of the virtual world (cyberspace) and the physical world in the form of Cyber-Physical-Systems (CPS). This era of manufacturing will bring changes in production methods, customer expectations and value creation. Due to these changes, Burmeister *et al.* [3] stated that the focus point should move from product and service innovation to business model innovation.

A case study is required in order to understand the business model of social manufacturing. Therefore an experiment is needed where a community or industrial cluster is used within a manufacturing process. An industrial cluster is the "social community and economic agents" [9] that collectively strives to produce a superior product and/or service. A social community is an ever-changing body of people. Thus, by using a social

media platform, their idea creation, knowledge and niche-spotting capacity could be harnessed to address seemingly overwhelming problems.

However it is very difficult to build a company around the idea that “The faster the product is produced, the more there is time to produce the next product”. Ben Kaufman, the founder of Mophie, launched Quirky in 2009 and had this mentality. Quirky was a start-up that “...pledged to help regular people turn their ideas into real products and sell them in stores nationwide” [10].

Value creation within social manufacturing cannot be described as a traditional process, where the consumer and the producer are separated from each other. Instead the consumer changes his role into a development competence consumer or prosumer [11]. The open design principle for value creation within social manufacturing follows a bottom-up approach [12] from which different types of patterns emerge where the underlying theory in this process is called, Emerging Synthesis [13]. Therefore using this case study as a social manufacturing experiment, patterns can emerge to use social media in the manufacturing process.

## 2 SOCIAL MANUFACTURING

Social manufacturing relies on the premise that personal and social networking relationships and ties provide value to organizations in a network by allowing them to tap into the resources embedded within the network for their benefit [1]. Zhang *et al.* [14] define social manufacturing as a new kind of networked manufacturing mode which integrates plenty of distributed socialised manufacturing resources and aggregates enterprises into manufacturing communities through initial clustering and self-organisation. Vukovic *et al.* [15] believe that web 2.0 technologies are the enabler of crowd sourced manufacturing.

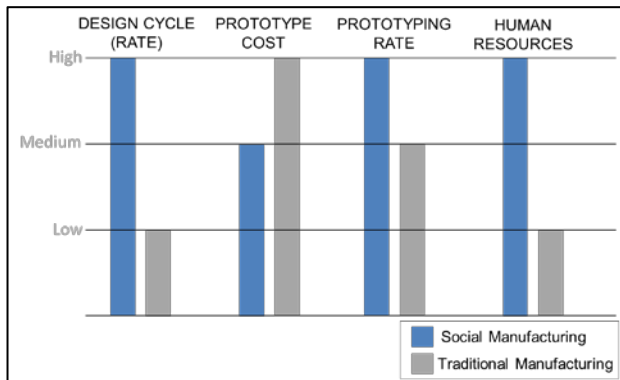
The idea of open design platforms is to change the way we construct knowledge around manufacturing itself, as the ability to generate new knowledge can have a significant role to stay competitive [16]. This leads to new methods in the way we solve problems and accelerate the process using of co-creation [8]. Social manufacturing is predicted to be used by the year 2020. The business model will use a pull (sale-produce-assemble) system as shown in Figure 2. Society will be sustainable conscious across the total value chain and will demand personalised products. The enabling technology for social manufacturing will be the internet of things and the key technology can be self-organizing systems. Information and knowledge processing will be based on cyber-physical systems.

Paradigm	Social Manufacturing	Existing Social Manufacturing companies
Paradigm begin	2020	Local Motors
Societal Needs	Personalised products on demand –Sustainability conscious	Opendesk
Market	Global production – demand fluctuation	Quirky
Business Model	Pull (sale-produce-assemble)	Shapeways – 3D printing
Enabling Technology	Internet of things	WindowFarms
Key technology	Self-organizing systems	Blender
Information & knowledge processing	Cyber-physical systems	OpenStructures

**Figure 2** - Social manufacturing elements (Adapted from [2])

Social manufacturing creates opportunities for internal related work or with corporate partners to have seamless access to relevant information, transfer and share documents and to automate manual tasks that can accelerate processes and decision making.

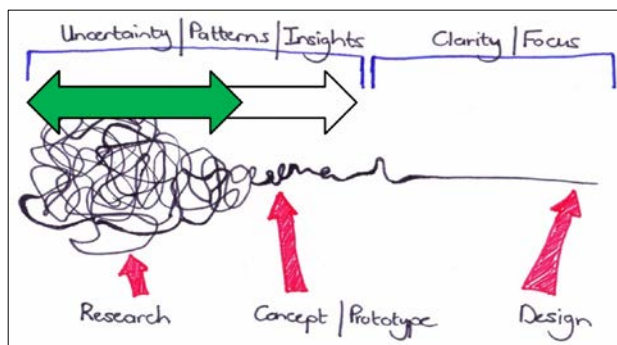
The difference between conventional manufacturing and social manufacturing companies is that anyone that has internet access can create and share their ideas or product designs online in an open design database. Once they have shared a design or idea, other people can contribute to the design by either making suggestions or improvements. Using more crowd sourcing and customer immersion service platforms in social manufacturing to identify patterns from emerging synthesis will shorten the design period. This will ensure faster identification of the required patterns and will help to develop customer demanded products. The second mayor difference of social manufacturing is that the manufacturing is done by the user/market and the manufacturing capability is embedded within the online community platform database. Social manufacturing will enable companies to design and prototype products faster, with access to more human resource on a platform at a lower cost than their competitors as illustrated in Figure 3.



**Figure 3 -** Comparing efficient utilization of social- and traditional manufacturing methodologies (not to scale – for illustrative purposes only) [2]

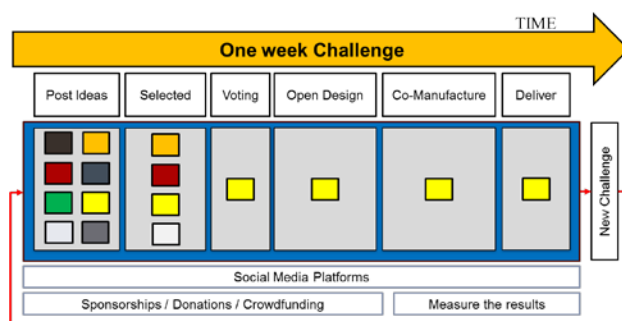
### 3 RESEARCH METHODOLOGY

The one week challenge goal is to use Social Media to complete the entire manufacturing process within a week. This is done by gathering data on the implementation of social manufacturing in an industrial cluster, such as the Industrial Engineering Department of Stellenbosch. With the use of social manufacturing the abstract design phases should become shorter as shown in Figure 4.



**Figure 4 -** The effect of open design on the design process during product development [2]

This can lead to a faster identification of market and customer requirements which decreases the manufacturing process time. Using the concept from Figure 4, a framework was developed for the one week challenge as illustrated in Figure 5.



**Figure 5 -**One week challenge framework illustrating the community selection, open design and co-manufacturing process steps

The one week challenge starts by posting a problem on Social Media. Crowd sourcing starts where

people posts ideas as possible solutions, the best ideas is used in a voting pole. The winner from the voting pole is then used as the product that needs to be manufactured. This entire process happens in one week from the initial idea sourcing to the delivery of the manufactured product as illustrated in Figure 5. After the final product is delivered a new problem is posted on Social Media, then the process is repeated.

In order for the one week challenge to be successful, a few requirements were set:

- Keep the product functionality simple
- Use 3D-printing in manufacturing process
- Use social media to develop the final specification for the product
- Try to use the least amount of resources
- To deliver the packaged product within the time period.

A description on the proceedings of the one week challenge day by day will follow below.

#### 3.1 Monday: Establish Social Media platforms

The goal of the first day was to set up the project on various social media platforms, and present with content that the industry cluster could relate to. To attract participation to this project, Facebook and Instagram accounts were used to exchange information with the industrial cluster. This project description was fully described in text format on the separate accounts, but made use of graphics and short videos to amplify its appeal. The secondary goal of the first day was to establish a connection with the industrial cluster and to encourage engagement. This was the most challenging task of the week and could be a crucial task for any social manufacturing project.

#### 3.2 Tuesday: Product Specification

The second day was dedicated to understanding what the industrial clusters' needs are, and how to meet them. Evaluation of their input on the social media platforms with regards to the initial published solutions which purpose was to stimulate engagement.

This process was dependant on the reach and followers gained on the first day on the Social Media platforms. Where the previous goal was to get followers on the Facebook and Instagram accounts, the second day's goal was to force feedback or engagement. This was achieved by heavy advertising and promoting some of the Facebook page content.

The promotion was enhanced by creating a Facebook event where subscribers could publish and vote for the product that would eventually be designed and manufactured. The list of potential products was comprised of suggested products that were posted or "liked" by the subscribers.

#### 3.3 Wednesday: Product Design

At this stage of the one week challenge, the project was quite established and our followers were

steadily increasing over both of the social media platforms. The final product was chosen so that the design for the product could be generated.

The demo model was printed on a 3D printer provided by the Industrial Department's RPD lab. The first printed product was a rough printed product to enable further investigations on finishing and quality.

### 3.4 Thursday: Manufacturing and Quality

The final product is manufactured on the same 3D printer only using an improved design and tolerance for a higher quality product. The timeline for the delivery of the product is the next day therefore using knowledge gained from manufacturing the previous demo model, the final product could be manufactured in time.

### 3.5 Friday: Package, deliver and social media feedback

The final day of the one week challenge was to deliver the product after some paint was added to the now successfully 3D printed product. This hype (on Social Media) peak was reached with a succession of posts and some reposts of previous highly attractive posts to get the target group involved and excited for the revealing of the actual product.

## 4 RESULTS OF THE CASE STUDY

The final product, a Baymax paperweight modelled from Disney's movie Big Hero 6, is shown in Figure 6, was delivered to the Industrial Department's secretary. The product had the most votes and thus created the most hype and it served its purpose where it would be used daily by the secretary to create order on her desk.



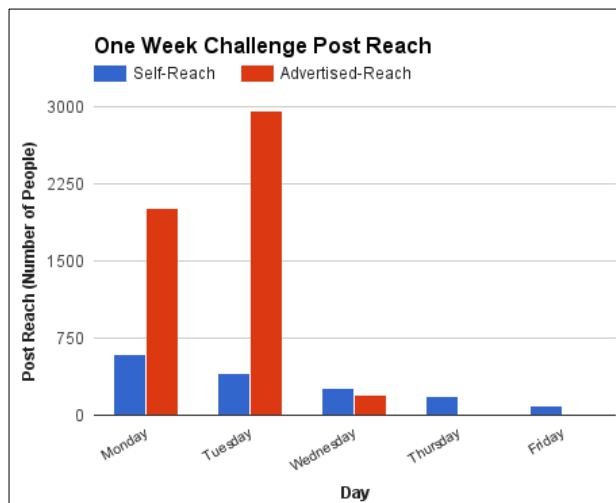
**Figure 6** - The community selected, open designed, co-manufactured product

The results of the one week challenge Facebook page will be discussed in the following categories: Post Reach, People Engaged by Gender and Age, and People Engaged by Location. All the data was accumulated and presented in the Facebook page administrative section.

### 4.1 Post Reach

Post Reach is the amount of people that were able to view the posts surrounding the one week challenge. Figure 7 represents Post Reach as divided along two types namely Self-Rich and Advertised-Rich. Self-Rich is the amount of people who viewed posts from the one week challenge Facebook page and/or got in contact with the content through friends commenting, liking or sharing the content. Advertised-Rich occurs when you promote a page or posts via Facebook, which significantly improved one's reach. Over the course of the week, two posts were promoted to compare their reach and test the varying effectiveness of graphic and video posts.

The Self-Rich was directly relatable to the amount of posts that were posted on the one week challenge Facebook page and was mostly aligned with the same amount of people that was currently subscribed to the page. Although the Self-Rich wasn't as substantial as the Advertised-Rich, it serves as a better indication of how much contact the project had with the industrial cluster.



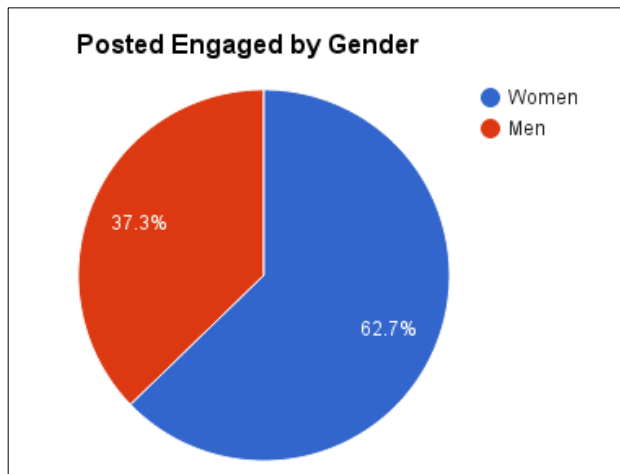
**Figure 7** - Post Reach illustrating the number of people reached during the challenge

The Advertised-Rich has two major points of interest. The first day, an investment of seventy rand over the course of one day for a graphic explaining the one week challenge and just over two thousand people that made contact with this post. The second day a promotion of a video for the same amount and duration was done. The expectation was to receive a much higher contact reach, but only received just more than three thousand contacts. This indicated that although videos were commonly accepted to be better at getting information across, it still only reached the same amount of contact compared to a simple graphic that had the same information on it.

### 4.2 People Engaged by Gender and Age

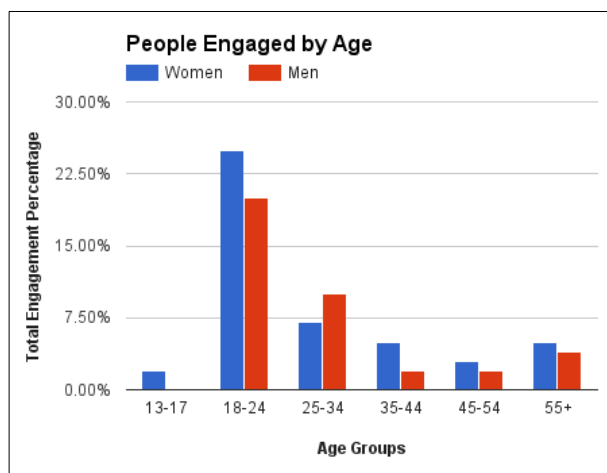
As can be seen in Figure 8, more female subscribers engaged with the posts made in the one week challenge Facebook page than men. This may be due to our product being for a female secretary and therefore relates more to women.





**Figure 8** - People Engaged by gender during the challenge

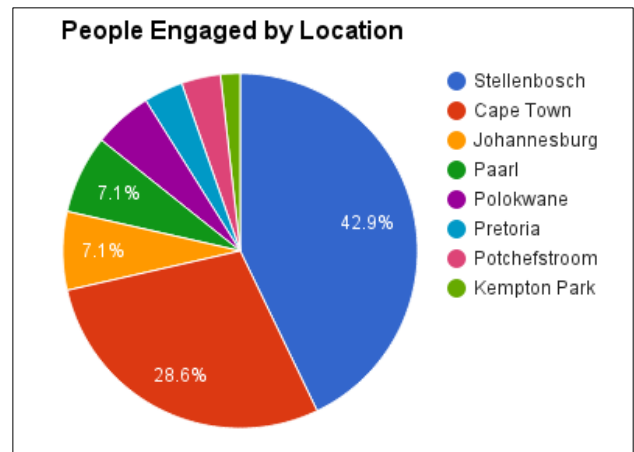
Figure 9 shows the age distribution chart of the people that engaged on the Facebook page. The one week challenge successfully achieved majority engagement in the age groups between eighteen and twenty four by a combined total of just over forty percent. If the age bracket between eighteen and thirty-four is totalled then the combined engagement is two thirds of the total engagement. This reinforces the fact that we reached our desired industrial cluster of young adults.



**Figure 9** - People Engaged by age during the challenge

#### 4.3 People Engaged by Location

The focus area, industrial cluster, consisted of Industrial Engineering students of the University of Stellenbosch, and by examining the pie chart in Figure 10, it is clear Stellenbosch had the most people that engaged on the one week challenge Facebook page. Furthermore, if you combine Stellenbosch's number of engagement with that of Cape Town and Paarl (which are two towns in close proximity of Stellenbosch), then the engagement by location comprises of more than three quarters of the total engagement. Both these above-mentioned facts thus prove that we succeeded in reaching our desired industrial cluster.



**Figure 10** - People engaged by location during the challenge

The results show that when you compare a simple social manufacturing project to a traditional manufacturing project, the amount of customer engagement is higher. More superior designs could be achieved faster when social media is incorporated. In total fifty-eight people engaged in this one week challenge where, for instance compared to a traditional project, only a handful of people would engage on customer data and specifications and it might take up to month to achieve the same output.

## 5 CONCLUSION

The business model elements of social manufacturing are explored and discussed. Compared to traditional design processes the research and conceptual design phases become shorter in social manufacturing. The case study provided valuable data with regards to crowd sourcing. This case study also proved that a product can be designed, manufactured and delivered within a week using social manufacturing methodologies. These experimental results illustrated the business benefits of taking the intellectual property issues out of the product development equation.

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## 7 BIOGRAPHY



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